is needless to point out what an interest it possesses for the student of the Old Testament, or what important bearings it is likely to have upon the criticism of the Pentateuch. The most unexpected part of the discovery is the fact that the medium of literary correspondence was the Babylonian language and script. It is true that here and there we come across evidences that the writers were not of Babylonian origin, as when the king is called a 'sun-god,' in accordance with Egyptian ideas, or when the first personal pronoun is expressed by the Phœnician *anuki* instead of the Assyro-Babylonian *anaku*. But the language of Babylonia is generally correctly written, and the scribes show that they had acquired a very thorough knowledge of the complicated cuneiform syllabary. It is evident not only that good schools existed throughout western Asia, but an acquaintance with Babylonian literature as well. We can now explain the presence of the names of Babylonian deities, like Nebo or Rimmon, in Canaan, as well as the curious resemblances that exist between the cosmologies of Phœnicia and Babylonia. Perhaps the most important result of the discovery is the evidence it affords us that some parts, at any rate, of the books preserved in the libraries of Canaan, were written in cuneiform characters, not upon papyrus, but upon imperishable clay. There is therefore some hope that when the excavator is able to exhume the buried relics of cities like Tyre or Kirjath-Sepher, 'the town of books,' he will find among them libraries similar to those of Assyria or Babylonia. Not only do we now know that the people of Canaan could read and write before the Israelitish conquest, we also know that they wrote upon clay. The 'scribes' mentioned in the Song of Deborah (Judges v. 6) have become to us living realities. The discontinuance of the old literary intercourse, and of the international language and script which accompanied it, must have been due to the advance of the Hittites and their long wars with the Egyptians, followed by the Israelitish invasion of Palestine. Western Asia was for a time a scene of bloodshed and disorder; Egypt had fallen into decay, and the cultured populations of Canaan were struggling for life and home. On the north were the Hittite tribes; on the south, the children of Israel. When order began to reign again, the influence of Babylonia had passed away, and its cumbrous syllabary had been superseded by the simple Phœnician alphabet. The date at which this was introduced into Phœnicia has now to be fixed by the progress of archæological research.

ELECTRICAL SCIENCE.

Disruptive Discharges and their Relation to Underground Cables.

THE paper read by Mr. E. G. Acheson before the National Electric-Light Association, on the above subject, was the most valuable contribution to our knowledge of underground cables that was given at the last meeting of the association. The object of the experiments described by Mr. Acheson was to find out under what circumstances the insulation of a wire carrying a high-tension current would be pierced by a spark. Some previous experiments on the discharge between points in air led to the equation

$$d = \frac{(\text{E.M.F.})^3 \times (\text{Capacity})}{a},$$

where d is the spark-length, and a is a constant for the dielectric, the capacity being expressed in micro-farads. For air, a was taken as 135, and d was expressed in inches. As the conditions which actually occur in practice are not discharges between two points, but between the cylindrical surface of the wire and some point outside the insulation, experiments were made to determine the value of a with this arrangement and with different dielectrics. The results give, in general, a greater value of a than when the points alone are used.

Dielectric.	Spark between.	a
Air	Points	135
Air	Point and wire	263
Paraffine and cotton	Point and wire	5,822
Ozite and cotton	Point and wire	7,759

To find what effect cracks in the insulation would have, Mr. Acheson took a broken plate of glass, the two parts of which were held firmly together. With a high electro-motive force, there was no discharge between two points on opposite sides of the glass when the solid part of the plate was between; but, when the points came abreast the crack, there was a spark. Another interesting experiment showed that a disruptive discharge, due to the breaking of a high-tension cable, would rather go through the insulation than through an electric arc.

To avoid any chance of a disruptive discharge through the insulation of the cable, especially if the latter be lead-covered, Mr. Acheson suggests that a wire be twisted around the outer lead covering, and the point be brought near to the bared surface of the conductor, the distance between them being adjusted until the discharge would pass between the conductor and the point rather than through the insulation.

In concluding his paper, the author says, "It is safe to predict, that, the disruptive discharge being provided for, little or nothing more would be heard of the much-talked-of pin-holes in the lead, and the moisture-absorbing terminals; the undergrounding of arc-light cables would become a thing of certainty, and our municipal governments relieved of a great bugaboo.

THE RECHNIEWSKI ALTERNATE-CURRENT MOTOR. — The adaptability of alternating currents for distributing light over an extended area has led a number of inventors to attempt to devise an electric motor that can be used on such circuits. The motor of Mr. Tesla, which has been described in this journal, is one of the most ingenious attempts in this direction, although there is yet considerable doubt as to its efficiency and regulating properties and its adoption would necessitate a complete change in the present method of distribution. It has been known ever since any attention was called to the subject, that an ordinary series motor would work on an alternating-current circuit, and Mr. Kapp has pointed out that a condition of maximum output is that the self-induction and counter electro-motive force of the motor should be equal. M. Rechniewski's motor is of the inverted Edison type, the field-magnets and armature-core being both built up with thin iron plates. The armature is of the drum type, and is large compared with the field-magnets. No data as to the performance of the motor are obtainable, but the following figures, taken from the *London Electrician*, give some idea of its construction: —

Volts at terminal	115
Current in ampères	100
Revolutions per minute	1,400
Diameter of armature	8 in.
Peripheral velocity in feet per minute	2,800
Weight of iron in field	440 lbs.
Weight of iron in armature	108 lbs.
Section of iron in field	42.5 sq. in.
Section of iron in armature	33.5 sq. in.
Induction in armature	3,700,000 lines.

The motor is not self-regulating, but it can be governed in the same way as some of the continuous-current motors.

MEASUREMENT OF ILLUMINATION. — M. Mascart has invented a photometer that enables him to compare the illumination produced by two sources of light. The standard lamp illuminates a plate of ground glass, an image of which, formed by a lens, is thrown after two reflections on a second plate of ground glass, called the 'test-glass.' The general diffused light of the room to be tested illuminates a translucent screen, the rays emitted from which are reflected at an angle of forty-five degrees, and fall on the other half of the test-glass. The light from either source can be more or less cut off by sectors. In lighting similar rooms of different sizes, it would appear at first that the source of light should vary in intensity with the square of the dimensions. It is found in practice, however, that the quantity of light varies as the cubic contents of the room. We may, from a consideration of the limiting distance at which a source of light ceases to be effective, get an idea of mean illumination. If, for instance, the limiting distance is ten metres, and the mean illumination one carcel at one metre, then the illumination should be .16 of a carcel per cubic metre. Comparing the illumination of public buildings during this century leads to the conclusion

that the public demands a much brighter illumination than formerly, and this increase of illumination has by no means reached a maximum.

A NEW INSULATING COMPOUND. — The following, from the *Electrical World*, is taken from the *Chronique Industrielle:* "The compound is composed of one part of Greek pitch and two parts of burnt plaster by weight, the latter being pure gypsum raised to a high temperature and plunged into water. This mixture, when hot, is a homogeneous viscous paste, and can be applied with a brush or cast in moulds. It is amber-colored, and possesses the insulating properties of ebonite, and can be turned and polished. Its advantage is its endurance of great heat and moisture without injuring its insulating properties."

SPECIFIC RESISTANCE OF MERCURY. — Since the absolute unit of electrical resistance has been defined in terms of a column of mercury of one millimetre cross-section and of a given length, a number of determinations of the specific resistance of mercury have been made. The latest is by Messrs. Glazebrook and Fitzpatrick, and gives for a result that the resistance of a column of mercury one millimetre in cross-section and one metre long is $r = 0.95352$ B. A. units. The other results that have been obtained are —

Observer.	Date.	Value for r in B. A. Units.	Value of Ohm in Centimetres of Mercury at 0°.
Lord Rayleigh and Mrs. Sidgwick	1883	0.95412	106.23
Mascart, Nerville, and Benoit	1884	0.95374	106.33
Strecker	1885	0.95334	—
L. Lorenz	1886	0.95388	105.93
Rowland	1887	0.95349	106.32
Kohlrausch	1888	0.95331	106.32
Glazebrook and Fitzpatrick	1888	0.95352	106.29

ELECTRIC TRAMWAYS IN SALT-MINES. — In the new Stassfurt mine an electric tramway has been in operation since January, 1884. It was built by Siemens & Halske, and was a success from the start. The engine is of 20-horse power, and is placed above ground at the mouth of the shaft. The dynamo is compound wound, and gives about 40 ampères at 300 volts. The current is taken through cables to the tram-line, a distance of 410 metres. The motor is supplied from overhead iron conductors, insulated from the ground. The motor is simply one of the well-known type of Siemens dynamos, placed horizontally on a car to economize space. The dynamo supplies about 20-horse power of energy; the motor gives about 10-horse power, — an efficiency of only fifty per cent. The weight of the wagons to be drawn is about 2,500 pounds, and there are sixteen in a train. The mean speed is about six miles per hour. This line is not in any way so efficient as those that can be put up to-day, but some figures as to the cost of working are of interest, especially as the road has been long enough in operation to allow an accurate estimate to be made. In 1884, 176,196 trucks were handled; and the working cost, including all items, wages, fuel, etc., with fifteen per cent for interest and depreciation, was 10.1 pfennig (about 2½ cents) per truck, while the cost before had been 20 pfennig (5 cents). In 1887 the figures are still more favorable, as the underground electric way had been considerably increased. The cost was 8.3 pfennig (about 2 cents) per truck, or 12.92 pfennig per kilometre ton, as compared with 34.2 pfennig per kilometre ton by human labor, which the electricity displaced. If the few electric tramways in mines that are now in operation in this country were investigated as to cost, it would be found that their economy is as great as that given above. It is only a question of a few years when mule and man power in mines will be replaced by electric motors.

MICHEL EUGENE CHEVREUL, the chemist, entered his hundred and third year on Aug. 30. He is still active, and a few days ago was able to visit the Sanitary Exhibition at the Palace of Industry.

BOOK-REVIEWS.

Eclectic Physical Geography. By RUSSELL HINMAN. Cincinnati, Van Antwerp, Bragg, & Co. 12°. $1.

"THE aim of this book is to indicate briefly what we know or surmise concerning the proximate causes of the more common and familiar phenomena observed at the earth's surface. Even thus restricted, the field of inquiry encroaches to a greater or less extent upon the domains of all the branches of science. Since the study of physical geography precedes that of the sciences in most of our schools, it has been thought advisable to present, in the form of an introductory chapter, a condensed statement of the more important and fundamental scientific conceptions regarding the properties and phenomena of matter and energy, such as inertia, gravitation, cohesion, affinity, and heat, light, magnetism, and electricity."

This passage, taken from the preface, shows the scope and object of the volume under review. The different parts of the subject are treated in the order used in all books of this character. Mathematical geography forms the first part. This is followed by meteorology, oceanology, geophysics, and biology. The book is illustrated by many maps, in which the most recent discoveries and researches have been made use of, and which, considering their smallness, are quite satisfactory, and undoubtedly superior to those defacing most American text-books of geography. In a number of maps the author has preferred to omit the system of meridians and parallels; it seems to us, not to the advantage of these maps. The great number of maps, and the fact that they are copied from the best authorities available, make the book very useful to the student. The chapters on meteorology and geophysics are the best parts of the book, while in that part treating of the oceans we find many statements that are not entirely in accord with the views held by the best writers. We particularly object to the method of the author of describing theories advanced by individual authors, but not generally accepted, — for instance, Murray's theory of the origin of deep-water deposits, and Ferrel's theory of ocean-currents, — as firmly established facts. A book of the character of this 'Eclectic Physical Geography,' if giving as much theory as the present one does, ought to give the views of opposing parties, and not favor one to the exclusion of another. In Part IV. the author gives first an outline of the topography of the earth, which is generally not treated in books of this character. After a brief treatise on weather and climate, the forms of life are discussed. It seems to us that the author, in this the last part, does not do full justice to his subject, his treatment being too brief, and his views not quite clear in all respects. Evidently it is his opinion that the principal part of geography consists in the study of geophysics. The book is, on the whole, well adapted to be used in the higher grades of teaching geography, although it might have been better to treat theories less dogmatically.

The Chemical Analysis of Iron. By ANDREW ALEXANDER BLAIR. Philadelphia, Lippincott. 8°. $4.

IN this book Mr. Blair describes those methods of analysis which, in his extended experience, he has found to be of most value to the iron-chemist. The first twenty-two pages of text are devoted to the description of the necessary and most suitable apparatus; twenty-one pages treat of the re-agents; then follow detailed methods for the analysis of iron and steel, iron ores, limestone, clay, slags, fire-sand, coal and coke, and furnace gases; tables to facilitate the calculation of analyses follow; and the book ends with a very complete index.

The work is well done, the arrangement good, the descriptions clear and to the point, the illustrations excellent. It forms a manual which must prove of the greatest assistance to those entering this field of work, while those who are already familiar with this branch of technical analysis will find it a convenient reference-book, and doubtless gain from it a number of valuable suggestions.

In Fresenius's 'Quantitative Analysis' (sixth German edition) fifty-two pages of the 'Special Part' are given to methods for analyzing iron and iron ores, and Bolley's 'Handbuch' contains seventy-seven pages on the same subject; but this is, so far as we are aware, the first complete work containing between its covers not only all the best methods for the analysis of all materials directly